

*Invariant Imbedding and Neutron Transport
Theory III—Neutron-Neutron
Collision Processes*

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1. Introduction. In previous papers in this series, [2, 3, 4], we have considered neutron transport models in which various types of collisions (scattering, absorption, fission) were allowed to occur between the moving particles and fixed nuclei. The effects of collisions between neutrons were not considered. In the current investigation we include this process, as well as the others, assuming that the new type of collision results in the annihilation of the particles involved.

Considerations are again confined to a one-dimensional model, though particles with several possible energy states are included. The concept of invariant imbedding, [1], is used to derive the functional equations which constitute a mathematical description of the physical processes.

First, the internal flux equations are derived, assuming a very general and physically reasonable neutron-neutron collision law. A special case is then investigated in some detail. The equations so obtained are amenable to analysis, although not easily solved explicitly. It is worthwhile, then, to present the results of some numerical experimentation.

The analytic treatment shows that, regardless of the magnitude of the cross section for collision between moving neutrons, there is no critical length (mass) for the rod. Arbitrarily large fluxes may be obtained, as might be imagined, if the source is strong enough.

The analogy between this situation and that in hydrodynamics, where the addition of an arbitrarily small viscosity term eliminates the discontinuous shock phenomenon, is then pointed out.

Various interconnections among internal fluxes and transmitted and reflected fluxes are exhibited for the models considered. They are, of course, more complicated than those described in [4], where the effects of collisions between moving particles were neglected.

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